

**MIDWEST CENTER FOR OCCUPATIONAL HEALTH AND SAFETY  
EDUCATION AND RESEARCH CENTER**

**SUMMARY ANNUAL REPORT  
July 1, 2013 – June 30, 2014**

**NIOSH TRAINING GRANT  
No. T42 OH 008434**

**SUBMITTED BY:**

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**MIDWEST CENTER FOR OCCUPATIONAL HEALTH AND SAFETY (MCOHS)  
EDUCATION AND RESEARCH CENTER (ERC)**

## **SECTION I: ERC Summary**

The mission of the Midwest Center for Occupational Health and Safety (MCOHS) Education and Research Center (ERC), as a center of excellence, is to provide: 1) cutting-edge interdisciplinary academic and research training to prepare exceptional leaders who make significant contributions to occupational safety and health (OSH), and 2) continuing education (CE) to prepare professionals to address current and emerging threats to the nation's workforce.

**Objective:** To address the need for an adequate supply of qualified personnel to carry out the purposes of the Occupational Safety and Health Act and reduce the national burden of work-related injury and illness in the Midwest region served by the MCOHS, and beyond.

**Rationale:** A previous conclusion in an Institute of Medicine report, that remains true, stated, "...the continuing burden of largely preventable occupational diseases and injuries and the lack of adequate occupational safety and health (OSH) services ...indicate a clear need for more OSH professionals at all levels." Further confirmation is noted in the recent NIOSH-commissioned report, "National Assessment of the Occupational Safety and Health Workforce," identifying needs that greatly exceed available trained OSH professionals.

**Design:** An innovative administrative structure, guided by a strategic plan and committed advisory board, supports enhanced efforts in interdisciplinary research, education, and outreach, including research-to-practice, and strengthens diversity recruitment. Rigorous graduate academic and research programs enable quality training in: Industrial Hygiene; Occupational and Environmental Medicine; Occupational and Environmental Health Nursing; Occupational Health Services Research and Policy; Occupational and Environmental Epidemiology; and Occupational Injury Prevention Research. While program duration varies, program expectations for degree completions are: masters' (~2 years); PhD (~ 4 years). In addition, a major CE Program offers novel courses in-person and through distance learning to meet the needs of a diverse workforce.

### **ERC Relevance:**

The MCOHS ERC serves the region of Minnesota, Wisconsin, North Dakota, and South Dakota and is a resource for industry, labor, federal, state, and local government agencies, agriculture, and numerous other partners. Recognized regionally, nationally, and internationally, it provides outstanding academic and research training programs and innovative Continuing Education programs to ensure the Center is positioned to continue to produce leaders who make important contributions to occupational safety and health.

### **Key Personnel:**

#### **MCOHS ERC Director**

##### ***Susan Goodwin Gerberich, PhD, MSPH***

*Mayo Professor and Leon S. Robertson Professor in Injury Prevention*

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## SECTION II: Program Highlights

### Industrial Hygiene (Six Highlights):

*Program Director: Gurumurthy Ramachandran, PhD, CIH, Professor*

#### **1. Quantitative Aid for Decision Making in Industrial Hygiene**

Dr. Ramachandran is working with several industry colleagues and three Ph.D. student trainees (two graduated and one current) to develop quantitative methods for incorporating professional judgment and exposure modeling into industrial hygiene decision-making. Two NIOSH-funded studies on this topic have looked at the accuracy and determinants of such decisions. The studies involved both desktop assessments (where participating OHs viewed videos of tasks, task information and sampling data) and walkthrough assessments (where they directly observed the task). Industrial hygienists from major companies as well as professional consultants are collaborating in the study. We have engaged several local AIHA sections (Minnesota, Alabama, Georgia) to carry out assessments with their member industrial hygienists. The key findings from the first NIOSH-funded RO1 study relating to quantitative judgments (made using monitoring data) are that (a) the accuracy of exposure judgments made by hygienists when monitoring data are available is low (<50% correct judgments) but still better than random chance (25%); (b) there is a significant underestimation bias in the exposure judgments, i.e., there is marked tendency to assign a lower exposure category than the correct one, thus increasing occupational risk to workers; (c) the low accuracy is likely due to cognitive biases in understanding skewed lognormal distributions. A training focused on heuristics relating to lognormal statistics significantly improves accuracy to ~70%. The second NIOSH RO1 study relates to using exposure models to improve judgment accuracy, and validate the use of these models in different occupational scenarios.

#### **2. Midwest Emerging Technologies Public Health and Safety Training (METPHAST) Program**

The key to avoiding health and safety issues with emerging technologies is to anticipate exposure risks and take action to mitigate them before they occur. To ensure that we anticipate these risks so that emerging industries grow without causing illness or injury to workers or the public, the University of Minnesota, the University of Iowa, and Dakota County Technical College have formed the METPHAST Program with recent funding from the NIEHS. Dr. Raynor is the principal investigator for the program and Dr. Ramachandran is a co-investigator. The objective of the METPHAST Program for the funding period is to develop a comprehensive array of focused, web-based modules that can be used by instructors to tailor education and training initiatives on nanotechnology health and safety to serve the unique needs of different learners. To achieve the objective, we are developing web-based materials to train professionals to work safely with engineered nanomaterials, establish on-line academic courses for undergraduate and graduate training on the principles of working safely with nanomaterials, and raise awareness of our modules, activities, and academic curricula through publications and conference presentations. Learners who will use training materials developed by the METPHAST Program will include: industrial hygiene students; students in other health, science, engineering, and technology disciplines; specialists who require focused continuing education on the health and safety of specific emerging technologies; and secondary and post-secondary students who may be exposed to individual lessons chosen by their instructors. This program is innovative because it will streamline and integrate academic and professional training to meet the needs of specific learners.

#### **3. Exposure Assessment in the Taconite Industry**

Drs. Ramachandran and Raynor and two PhD student trainees (now graduated) have conducted comprehensive measurements of personal exposures to elongated mineral particles (EMPs), and respirable dust and silica in six taconite mines in northeastern Minnesota in this project funded by the State of Minnesota. The results are being used for an epidemiological study of mesothelioma, lung cancer, and silicosis in taconite workers. This project is relevant to the Mining sector of the National Occupational Research Agenda (NORA). It also addresses several of the priority Cross-sector research areas: exposure assessment; mixed exposures; respiratory disease; and epidemiology. The aims of this research are also key goals of the NIOSH Roadmap for Research relating to asbestos fibers and other EMPs (NIOSH, 2011) and will have impact at the national as well as regional levels: a) develop a broader and clearer understanding of the important determinants of toxicity for non-asbestiform EMPs, including dimensional attributes (length, width and aspect ratio); b) develop information on occupational exposures to various EMPs and associated health risks; c) enhance the

understanding of different exposure metrics and their impact on disease measurement; d) evaluate the risk of specific disease in relation to these exposures.

#### **4. Effects of Spray Surfactant and Particle Charge on Respirable Dust Control**

A PhD student trainee is working with Dr. Raynor on a project to determine if sprays with surfactants having certain ionic properties can capture respirable dust particles carrying certain levels and sign of charge more effectively than sprays with surfactants having different ionic properties. The long-term goal of this line of research is to reduce respirable dust concentrations in underground coalmines by improving engineering control technology. The objective of this specific project is to measure how efficiently sprays, containing different types and concentrations of surfactants, collect laboratory-generated aerosol particles carrying various levels of electrical charge. The objective is being achieved by accomplishing the following three specific aims: a) Design and build a test apparatus to measure the ability of sprays to collect airborne particles; b) Measure the spray collection efficiency for polystyrene latex (PSL) spheres using several spray surfactants; and c) Measure the spray collection efficiency for a polydisperse coal dust using several spray surfactants. Results, thus far, show that particle diameter is a more important determinant of spray collection efficiency than particle charge or spray surfactant type or concentration. Nonetheless, surfactant type and concentration affect collection efficiency significantly. In particular, particles that are strongly charged are collected much more efficiently by surfactant spray droplets with opposite charges than they are by surfactant sprays that carry the same charge. The expected outcome of this research will be a set of recommendations for surfactant types that can be used most successfully in sprays to enhance capture of respirable coal dust particles that carry specific signs and magnitudes of charge. The data generated in this study have national implications and will assist mine operators in making informed decisions about the type of surfactant to use in spray systems to maximize dust capture, depending on the characteristics of the coal being mined.

#### **5. Assessing inhalation exposures of clean-up workers during the BP oil spill**

A PhD student trainee (now graduated) worked with Dr. Gurumurthy Ramachandran to develop an inhalation exposure assessment strategy in the context of an epidemiological study being conducted by the National Institute of Environmental Health Sciences (NIEHS) to investigate adverse health effects of the workers engaged in clean-up after the BP oil spill. Exposures to several chemical agents were assessed over several time periods after the spill that were: a) derived from the type of task they were performing or proximity to a task in a given geographical location during the work shift; b) derived from the workers' location in the proximity of clean-up operations during non-work shift hours. Classification of workers into "exposure scenarios" were on the basis of a combination of job task, geographical location, and time point where workers' exposures were similar for the array of chemicals in the spilled oil as well as the dispersant to which the workers were exposed. Assessments were carried out for total hydrocarbons, benzene, toluene, xylene, ethylbenzene, n-hexane, and PM2.5. Personal exposure and area concentration measurements were available from BP company records as well as from federal agencies such as NIOSH, USEPA, and NOAA. The data associated with each exposure scenario were used to estimate the arithmetic mean (AM), standard deviation (SD), geometric mean (GM), and geometric standard deviation (GSD). A vast majority of the data is below the limits of detection and, therefore, methods for censored data analysis such as the beta substitution method, the maximum likelihood estimation, and the Kaplan-Meier non-parametric methods have been evaluated. Bayesian techniques have also been developed for this purpose.

#### **6. Measurement of Particle Sizes Associated with Airborne Viruses**

Dr. Raynor is working with colleagues on a project to find optimal ways to measure the particle sizes with which live airborne viruses are associated. The long-range goal of this research is to identify ways to minimize the transmission of infectious viruses through air to people working in professions at risk. To determine what technologies and procedures will be most effective at reducing the transmission of virus-containing particles, we must know the size of particles with which viruses are associated. Therefore, the objectives of the research are to develop and validate a method to determine virus concentration in air as a function of particle size and to use the method to measure the particle sizes with which airborne viruses are associated in occupational settings.

Thus far, we have used non-viable impactors to successfully sample six different viruses in laboratory tests. In addition, we have sampled influenza viruses in swine production operations, with limited success in keeping the viruses live. Further laboratory research suggests that size separation followed by collection on dissolvable gelatin filters may keep the virus live longer than will collection by impaction. Critically important knowledge will be gained when a method is developed to measure the particle sizes with which viruses are associated. In

particular, knowledge will be gained on how far infectious airborne viruses can be transmitted, how deeply into the lungs they may be inhaled, and the most effective manner for controlling airborne exposures to the viruses.

### **Occupational and Environmental Medicine Academic Training Program (Three Plus Highlights)**

**Academic Program Director:** *Jeffrey H. Mandel, MD, MPH, Associate Professor*

#### **1. An Investigation of Minnesota's Iron Ore Mining Industry**

This five-year study consisted of multiple components (see below). Faculty from occupational/environmental medicine, industrial hygiene, occupational epidemiology and geology participated. Several residents and graduate students participated in this research. This is the most extensive investigation of this industry that has been undertaken. It was a unique effort, and included all current and former mining operations, dating back to the origin of the industry in Minnesota. Further details may found at <http://www.taconiteworkers.umn.edu>. Additional details may be found in the Occupational and Environmental Epidemiology program report.

**a. The investigation included a comprehensive industrial hygiene exposure assessment of all currently active mines.** This work focused on three primary exposures including elongate mineral particles, silica and respirable dust. Over 2000 measures were taken across all currently active mines. Historical data from the mining companies and from the Mining Safety and Health Administration were used to estimate past exposures. A job-exposure matrix was created which included estimated concentrations for all three exposures for each year beginning in the 1950s and extending through 2010.

**b. A general cohort mortality study was completed.** This study assessed the vital status and cause of death for all taconite miners who worked in the industry between 1960 and 2010. The cohort included 31,067 workers with at least one year of documented employment.

**c. Nested case-control studies were completed for the lung cancer and mesothelioma cases.** Case ascertainment was done using mortality data as well as the state's tumor registry for both of these diseases. Information on exposure estimates, from the above exposure assessment, was used to explore the role of mining and disease risk.

**d. A cross-sectional screening of current and former workers and their spouses was completed.** This included 1188 workers and 496 spouses. Using chest x-rays and on-site, screening spirometry, individuals with non-malignant lung disease were identified. Exposure information obtained through the above industrial hygiene work was used to explore exposure-disease relationships.

**2. Additional areas of research collaboration have been funded that involve OEM faculty as collaborators.** These projects will add to existing research projects as potential areas for resident research involvement. The new projects include:

**a. Enhanced exposure characterization of elongate mineral particles in the taconite industry of Minnesota**

**b. Environmental exposures and Parkinson's Disease in Minnesota**

**c. The use of an Occupational Health and Safety Assessment Tool with regional businesses through multicenter NIOSH funded grant (SafeWell)**

#### **3. Other Highlights**

Drs. McKinney and Cusic held board positions in the Central States Occupational/Environmental Medicine Association. Dr. Shawn Olson has been elected to ACOEM's Residents and Recent Graduates Section.

### **Occupational and Environmental Health Nursing (Five Highlights):**

**Program Director:** *Patricia M. McGovern, PhD, MPH, RN, Bond Professor of Environmental and Occupational Health Policy*

**1. Public Health Institute reaches 256 students from 17 states and 16 countries and provides 35 public health-related courses in 2013.**

Dr. Debra Olson leads the School of Public Health's Public Health Institute (PHI), an annual event that is a forum for discussion of emerging public health issues and experiential learning; courses are offered for graduate level academic credit or continuing education. On average, 250 unique participants register for over 600 total credits on an annual basis. Faculty and students from several countries and states in the U.S. attend

the PHI each year, reflecting a new era of interdisciplinary collaboration to strengthen and advance global environmental and occupational health perspectives and global public health practice and leadership. Courses have been developed in different concentration areas and now include courses in: Applied Biostatistics and Research Methods; Culturally Responsive Public Health Practice; Environmental Health Sciences (e.g., “Ergonomics and Prevention of Workplace Hazards,” “Personal Protective Equipment and Respiratory Protection”); Food Protection; Global Health; Infectious Disease Epidemiology; Public Health Leadership and Management; Public Health Preparedness, Response and Recovery; and Woman and Child Health and Nutrition.

## **2. Necessary Drugs, Unnecessary Consequences: An Intervention to Protect Oncology Health Workers**

Catherine Graeve, MPH (OEHN PhD student), was awarded a MCOHS Pilot Project Research Training Award for her dissertation research, “Necessary Drugs, Unnecessary Consequences...” (Advisor: Dr. McGovern). Her study will develop and test an intervention to decrease exposure among nurses to antineoplastic drugs while they take care of cancer patients. This is significant for health care workers as no regulations govern their handling of these highly toxic drugs. Moreover, the literature has established that approximately 8 million health care workers are potentially exposed to these drugs, which are carcinogenic, mutagenic, and teratogenic. Studies have documented surface contamination of patient care areas with antineoplastic drugs and healthcare worker indicators of exposure. Because workplace culture affects use of safe handling precautions, research is sorely needed to determine worksite interventions to increase adherence to safety precautions and decrease exposures. Catherine’s study will develop, implement and evaluate an intervention to reduce worker exposure to antineoplastic drugs in three oncology units.

## **3. Family Medical Leave Duration and Protection from Maternal Postpartum Depression**

Rada Dagher, PhD, (Alumna, MCOHS Pilot Projects Research Training Program) collaborated with faculty, Drs. McGovern and Dowd to examine the relation between time off after childbirth and women’s risk of postpartum depression. Findings revealed the more leave time from work that a woman takes after giving birth -- up to six months -- the better protected she was from experiencing postpartum depression. Taking time off work is an important strategy for new mothers to rest and recover from pregnancy and childbirth, and adapt to the needs of a new infant. Such policies have the potential to improve the health of employed women and their families and result in a healthier and more productive workforce. [Dagher et al, 2014. *Maternity leave duration and postpartum mental and physical health; Implications for leave policies. Journal of Health Politics, Policy and Law* 39(2):369-416]

## **4. Testing a Sharps Injury Prevention and Biomedical Waste Program in Northern India**

Indian hospitals often do not have the resources to invest in safety devices and protective equipment to decrease this risk. Josh Gramling (OEHN PhD student) worked in collaboration with hospital staff to design and implement a sharps injury prevention and biomedical waste program in an urban 60-bed charity hospital in northern India. The program aligned with hospital organizational objectives and was designed to be low-cost and sustainable. Occupational health nurses working in international settings or with international workers should be aware of employee and employer knowledge and commitment to occupational health and safety. This paper was recently published [Gramling J, Nachreiner N, Implementing a sharps injury reduction program at a charity hospital in India. *Workplace Health and Safety* 2013;61:339–345].

## **5. Cancer and Treatment Effects on Job Task Performance for Gynecologic Cancer Survivors**

Over 91,000 new cases of gynecological cancers are expected to be diagnosed in 2013 in the US alone. As cancer detection technology and treatment options improve, the number of working-age cancer survivors continues to grow. Dr. Nancy Nachreiner (OEHN adjunct faculty) and colleagues described gynecological cancer survivors' perceptions of the effects of cancer and treatment on their job tasks for a sample of adult gynecological cancer survivors who were working at the time of their cancer diagnosis, treated at a University-based women's health clinic, and diagnosed in the previous 24 months. Fifteen percent of women had chemotherapy and radiation treatment; 48% had only chemotherapy, 9% only radiation therapy and 28% had neither. Survivors described the frequency of performing seven job tasks, such as 'intense concentration', 'analyzing data', and 'lifting heavy loads.' Women who had undergone radiation treatment were more likely to indicate limitations for physical tasks; women undergoing chemotherapy were more likely to report limitations in more analytic tasks. Only 29% of women noted an employer-based policy facilitated their return-to-work process. Cancer and treatment have important effects on job performance and may vary by type of treatment. Employer-based policies focusing on improved communication and work accommodations may improve the



return to work process. [Nachreiner et al, Cancer and treatment effects on job task performance for gynecologic cancer survivors. *WORK: A Journal of Prevention, Assessment and Rehabilitation* 2013;46:433-438]

### **Occupational Injury Prevention Research Training (Seven Highlights):**

**Program Director:** Susan Goodwin Gerberich, PhD, Mayo Professor and  
Leon S. Robertson Professor in Injury Prevention

**Program Co-Director:** Bruce Alexander, PhD, Professor

#### **1. Incidence of and Risk Factors for Occupational Injury among Transit Bus Operators**

Among a total of 2,095 bus operators, included in this study, designed and conducted by Dr. Chia Wei, former OIPRTP doctoral student, the overall unintentional injury rate with 95% C.I. was 17.8 (16.1-19.7) per 100 FTEs. Multivariable analysis identified increased risks for operators who: were female, compared to male (HR=2.4; 2.0-2.8); worked <7, compared to 7-<12 hours per day (HR=4.6; 3.8-5.5); and drove <7 compared to 7-<12 hours per day (HR=3.2; 2.7-3.8). Operators who worked split, versus straight shifts, demonstrated a suggestive increased risk (HR=1.2; 1.0-1.4). Bus operators also tended to have an increased injury risk when driving limited versus regular bus routes (HR=1.36; 1.0-1.8). The overall intentional injury rate was 1.4 (1.1-1.7) per 100 FTEs. Operators who commenced working between 3 p.m. and 6 p.m. (HR=2.4; 1.2-5.1) and 12 a.m. and 3 a.m. (HR=5.3; 1.6-18.2), had higher risks of intentional injury, compared to those who commenced work between 9 a.m. and 12 p.m. Moreover, those who worked overtime had 30% higher risks, compared to those who did not. Results of this study serve as a basis for further studies and are used for the development and application of relevant targeted intervention strategies in a metropolitan transit system to reduce occupational injuries among bus operators. Associated manuscripts are in review. (Funding: NIOSH Pilot Project T42 OH008434)

#### **2. Reducing the Burden of Injuries on Agricultural Operations**

Dr. Gerberich, OIPRTP, and the team of other MCOHS program co-investigators and students, lead major injury prevention studies that are the basis of regional research-to-practice efforts. These include surveillance studies of the incidence and consequences of, and risk factors for, agricultural and other injuries in Minnesota, Wisconsin, North and South Dakota and Nebraska. All age groups are included; however, there is also a primary focus on children and youth in this unique occupational environment. The study results and identification of intervention efforts are translated to practice through collaboration with regional Agricultural Extension leaders who work directly with operators and communities. Dissemination has also been accomplished through numerous peer-reviewed publications and presentations in local, national and international arenas. (Funding: NIOSH R01 OH008258)

#### **3. An Epidemiological Approach to Emergency Vehicle Advanced Warning System Development: A Two-Phase Study**

Motor vehicle crashes involving civilian and emergency vehicles (EVs; police, fire trucks, ambulances, etc.) have been a known problem that contribute to fatal and nonfatal injuries; however, characteristics associated with civilian drivers had not been examined adequately. This two-phase study designed and conducted by former OIPRTP doctoral student, Dr. Chris Drucker, analyzed data from: **Phase 1**) The National Highway Traffic Safety Administration's Fatality Analysis Reporting System and the National Automotive Sampling System General Estimates System to identify driver, roadway, environmental, and crash factors, and consequences for civilian drivers involved in fatal and nonfatal crashes with in-use and in-transport EVs and **Phase 2**) design and examination of the impact (based on driving performance and usability measures under distracting and non-distracting conditions) of two in-vehicle driver support systems which alert drivers to approaching EVs in a simulated urban environment. **Phase 1** identified drivers were involved in crashes with EVs more often when driving: straight through intersections (vs. same direction) of four-points or more (vs. not at intersection); where traffic signals were present (vs. no traffic control device); and at night (vs. midday). For nonfatal crashes, drivers were more often driving: distracted (vs. not distracted); with vision obstructed by external objects (vs. no obstruction); on dark but lighted roads (vs. daylight); and in opposite directions (vs. same directions) of the EVs. Consequences included increased risk of injury (vs. no injury) and receiving traffic violations (vs. no violations). Fatal crashes were associated with driving on urban roads (vs. rural), although these types of crashes were less likely to occur on dark roads (vs. daylight). [Recent publication: *Drucker C, Gerberich SG, Manser MP, Alexander BH, Church TR, Ryan AD, Becic E: Factors associated with civilian*



*drivers involved in crashes with emergency vehicles. Accident Analysis and Prevention 2013;55:116-123. PMID: 23524203*] **Phase 2**, using a portable driving simulator, indicated improved driver responses and roadway safety among drivers presented with the designed driver support system compared to drivers presented with no driver support system. Most notably, drivers were at decreased risk of collisions with EVs when given a driver support system and that the presence of the systems did not increase in-vehicle distractions. In addition, drivers indicated a moderate level of trust and lower mental workload scores when driving with the driver support systems and reported the systems to be somewhat useful and satisfying. The findings of this two-phase study suggest drivers may have difficulties in visually detecting EVs in different environments and that the use of technology may be beneficial as an intervention to mitigate roadway crashes between civilian drivers and EVs. Future research must continue to examine interactions between civilian drivers and EVs to identify methods to improve roadway safety. Associated manuscript is in review. (Funding: NIOSH Pilot Project T42 OH008434)

#### **4. Violence against Nurses: The Next Step**

Identification of risk factors for work-related physical assault by Drs. Gerberich, Nachreiner, Church, McGovern, their MCOHS colleagues, and students, are particularly important to application of relevant interventions. These risks include working in environments with low lighting, not carrying cell phones or alarms, working in emergency and psychiatric departments and long-term care facilities, and increasing hours of patient contact. Dissemination to professionals has been accomplished through numerous peer-reviewed publications and professional presentations. Some results from this and other studies have been incorporated into an online violence prevention course for which Dr. Gerberich participated in the development: Workplace Violence Prevention for Nurses CDC Course No. WB1865 - NIOSH Pub. No. 2013-155:

[http://www.cdc.gov/niosh/topics/violence/training\\_nurses.html](http://www.cdc.gov/niosh/topics/violence/training_nurses.html) Interest in this problem among nurses, and healthcare workers, in general, remains high. As an international, as well as a national problem, a major international conference will be held in Hong Kong in 2015, sponsored by the Hong Kong Hospital Authority; Dr. Gerberich has been invited to provide two relevant presentations, based on this research. (Funding: NIOSH R01 OH 03438)

#### **5. Preventing Violence against Teachers/Educators**

Dr. Gerberich, MCOHS research team colleagues, and students have been providing translation of research data from the Minnesota study of "Violence Against Teachers: Etiology and Consequences," to practice throughout the school systems, in collaboration with their dedicated advisory board of teachers. Risk factor identification, which serves as a basis for development of relevant interventions, includes consideration of various environmental factors, assault deterrents, violence policies, and school financial resources. To date, results have been disseminated in several peer-reviewed publications and at numerous major professional meetings, nationally and internationally, including audiences involving teachers. Important factors associated with student perpetrated Physical Assaults (PAs) against a large population of K-12 grade educators were identified through a case-control study. It is important that school administrators recognize the increased risks to less experienced educators with advanced degrees who teach in public schools in elementary grades with small numbers of students, who have disabilities or developmental impairments, and in classes where students are of a different race/ethnicity from the teachers. Based on the strong evidence of an inverse relation between parental involvement and risk of PA to the educator, it appears essential to address this issue rigorously. Moreover, attention to environmental factors, including lighting, accessible exits, school resources, and an environment focused on safety is key. These results provide a basis for development and testing of effective methods for controlling the substantial risk of PA among elementary and secondary school educators that may also benefit others within the school environments (Funding: NIOSH R01 OH 007816). [Recent publication: Gerberich SG, Nachreiner NM, Ryan AD, Church TR, McGovern PM, Geisser MS, Watt GD, Feda DM, Pinder E, Sage SK: Case-control study of student-perpetrated physical violence against educators. *Annals of Epidemiology* 2014;25(5):325-332. PMID: 24636615]

#### **6. An Epidemiological Study of the Magnitude and Consequences of and Risk Factors for Work-Related Injuries to Veterinary Technicians** (Study designed and conducted by Leslie D. Norgren, PhD, former OIPRTP student)

To determine the frequency, consequences, and potential risk factors for injuries among all Minnesota Certified Veterinary Technicians (CVTs, n=1,427), a cross-sectional study design was initially used; data were collected by mailed survey on demographics, personal characteristics, injury occurrences, and consequences from the

previous 12 months (74% response). Annual injury rates were estimated by demographic and work-related characteristics. Risk of injury associated with demographic and clinic factors was estimated using multivariate Poisson logistic regression models to calculate Incidence Rate Ratios. Among 873 eligible respondents, 1,827 injury events were reported by 465 CVTs (total and bite injury rates, 237 and 78 injuries per 100 persons per year). Higher rates were identified for: handling animals for <six years; working ≤three years as a CVT; and working in a mixed, mostly small animal clinic. Primary injury sources were cats (47%) and dogs (35%) and activities associated with animal restraint or treatment. Primary injury consequences included treatment and restricted work activity; most severe injuries involved bites, cuts/lacerations/scratches, bruises/contusions, and abrasions. Multivariate modeling identified decreased risks for working <40 hours/week; in mixed large/small, commercial, and government animal facilities. Increased risks involved: working in small or mixed, mostly small animal facilities; handling 4->6 animal species per day; and belief that injuries are not preventable; working <6 years was suggestive as a risk. Several exposures encountered in the CVTs' environments appeared to be associated with their injury risk and consequences. Beyond documented risks, investigation of additional exposures is integral to relevant intervention strategies. [Nordgren LD, Gerberich SG, Alexander BH, Church TR, Bender JB, Ryan AD: An epidemiological study of the magnitude and consequences of and risk factors for work-related injuries to veterinary technicians. Journal of American Veterinary Medical Association 2014;245(4):434-40. doi: 10.2460/javma.245.4.434.] (Funding: NIOSH Pilot Project T42 OH008434)

## **7. Evaluation of Risk and Protective Factors for Work-Related Bite Injuries to Veterinary Technicians Certified in Minnesota Technicians** (Study designed and conducted by Leslie D. Nordgren, PhD, former OIP RTP student)

To determine the risk or protective factors for work-related bite injuries among Certified Veterinary Technicians (CVTs) in Minnesota, a case-control study of CVTs working in small and mostly small animal clinics was conducted. Cases (n=176) were CVTs that reported a work-related animal bite injury in the previous 12 months; controls (n=313) reported no animal bites. Using a mailed questionnaire, exposure data pertinent to characteristics of the work environment and personal work practices were collected from cases (month prior to the bite injury) and controls (randomly selected working months) (61% response). Multivariate analyses, based on directed acyclic graphs for each exposure of interest, suggested that increased risk of bite injury (odds ratios, 95% confidence intervals) was associated with: age <25 years (3.82, 1.84-7.94) and 25 to <35 years (1.59, 0.97-2.60), versus age 35 and older; having <5 versus 10+ years experience (3.24, 1.63-6.45); "frequently" (2.02, 1.13-3.60) and "infrequently to never" (4.70, 0.94-23.5); versus "always" having adequate staff help available; and handling 5+ versus <3 animal species per day (1.99, 1.06-3.74). Decreased risks were identified for not having versus having a history of a prior bite injury (0.52, 0.27-1.01) and handling less than 10 versus 20+ animals per day (0.23, 0.08-0.71). From the study results, age, years of experience, staffing levels, history of bite injury, and number of animals handled on a typical day were associated with work-related bite injuries. These findings serve as a basis for development of intervention efforts and future research opportunities. [Nordgren LD, Gerberich SG, Alexander BH, Church TR, Bender JB, Ryan AD: Risk factors for work-related bite injuries to Minnesota certified veterinary technicians, Journal of American Veterinary Medical Association 2014;245(4):425-33. doi: 10.2460/javma.245.4.425. PMID:25075827] (Funding: NIOSH Pilot Project T42 OH008434)

## **Occupational Health Services Research and Policy Program (Five Highlights)**

**Program Director:** *Patricia M. McGovern, PhD, Bond Professor of Environmental and Occupational Health Policy*

**Program Co-Director:** *Brian Dowd, PhD, Professor*

### **1. Special Issue of Health Services Research Highlights Micro-Simulation Studies**

Professor Dowd co-edited, with Michael Hagan of the Agency for Healthcare Research and Quality (AHRQ), a special issue of Health Services Research featuring micro-simulation studies. Published in 2013, this issue includes papers that highlight the use of simulation techniques in rigorous, empirical health services research, especially articles which address methodological challenges and solutions to problems when using these techniques, as well as articles that feature simulations such as supply-side simulation, health care costs, and health care policy. Collectively, the articles showcase methodological innovation in simulation, provide concrete examples of the application of such methods, and address specific policy or intervention contexts. Simulation techniques provide timely guidance to decision-makers in the development of legislation, regulation, policy, and management because they can be used to evaluate effects of proposed interventions before they

are implemented in the real world. Important policy contexts for selected simulation articles include health care reforms, technological change, new global and public health challenges, market-driven organizational changes, and demographic changes.

## **2. New "Methods Corner" in Health Services Research**

Professor Bryan Dowd introduced a new, occasional series section of Health Services Research, the "Methods Corner," which aims to improve the practice of health services research. This section is devoted to explaining common estimation problems that arise in health services research and providing readers with the correct solution to the problem and computer code that allows the analyst to implement the solution. The series was introduced in an edition of Health Services Research (volume 47, Issue, part 1, 2012) and begins with an article entitled "Interaction Terms in Nonlinear Models" by Karaca-Mandic and colleagues which describes the best approach for estimating and presenting the results of nonlinear regression models that include interaction terms among the explanatory variables. While this topic has recently received attention in the economics literature, practice remains suboptimal in many of the articles submitted to Health Services Research and other journals in our field.

## **3. OHSRP trainee awarded Academy Health's Outstanding Dissertation Award**

Helen Parsons, PhD, OHSRP alumna, received the Outstanding Dissertation Award at the annual Academy Health Annual Research meeting. Her dissertation, "A Culture of Quality? Lymph Node Evaluation for Colon Cancer Care," has earned this prestigious award, which honors an outstanding scientific contribution from a doctoral thesis in health services research. Her research analyzed whether the number of lymph nodes was correlated with improved survival of individuals with colon cancer. Her work found that patients who had at least 15 nodes excised, also known as adequate lymphadenectomy, as opposed to those with one to seven nodes, experienced improved survival; this resulted in publications in JAMA, Medical Care, the Journal of the American College of Surgeons, and the Journal of Oncology Practice. Dr. Parsons is now working with the University of Texas Health Science Center at San Antonio in the Department of Epidemiology and Biostatistics.

## **4. New Partnership with the JourneyWell Program of HealthPartners Institute for Education and Research Opens Student Research Training Opportunities**

An OHSRP doctoral trainee is conducting an evaluation of the association between prolonged sitting and inactivity on back pain and productivity loss for a large employer enrolled in the JourneyWell Program. Working in collaboration with Dr. Nico Pronk, Vice- President and Health Science Officer for JourneyWell at HealthPartners, Professor McGovern, and dissertation committee members, Ms. Briggs' research will shed light on the independent effect and interactions of moving more and sitting less in association with back pain and productivity loss; this will contribute to the development of prevention strategies for employers in the service industry. This research training opportunity was supported by the Midwest Center for Occupational Health and Safety Educational Research Center Pilot Research Training Program (OH008434).

## **5. Time Off Work After Childbirth Decreases the Risk of Postpartum Depression in New Mothers**

Increased duration of leave from work after childbirth is associated with a decrease in depressive symptoms through six months postpartum. Findings from the Minnesota Postpartum Health Study revealed that the current leave duration provided by the Family and Medical Leave Act -- 12 weeks -- may not be sufficient for employed mothers at risk for or experiencing postpartum depression. This study examined the association of leave duration with depressive symptoms, mental health, physical health, and maternal symptoms in the 12 months after childbirth, using a prospective cohort design in a sample of employed women, 18 years or older, enrolled from three metropolitan Minnesota hospitals while hospitalized for childbirth. In the first postpartum year, an increase in leave duration is associated with a decrease in depressive symptoms until six months postpartum, revealing the impact of leave benefits in helping workers balance work and family commitments -- consistent with NIOSH's Total Worker Health™ initiative. Alumna, Rada Dagher, PhD, Assistant Professor, Department of Health Services Administration School of Public Health, University of Maryland and Professors McGovern and Dowd coauthored this paper published in 2014: *Maternity leave duration and postpartum mental and physical health; Implications for leave policies. Journal of Health Politics, Policy and Law* 2014;39(2):369-416. This research was funded, in part, by the grant 5R18 OH003605-05 from the National Institute for Occupational Safety and Health. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH. The 20th Anniversary of the Family and Medical Leave Act (FMLA) is a focus of Wisconsin Public Radio's Joy Cardin's Hour; August 13, 2013; John Munson, in for Joy Cardin, questioned Professor Pat McGovern if the Family Medical and Leave Act, has lived up to expectations

since it passed 20 years ago, after eight years of conflict and compromise in Congress? Professor McGovern discussed how employees use FMLA, and changes needed for more effective use of this benefit. Available online: <http://www.wpr.org/wcast/download-mp3-request.cfm?mp3file=jca130808a.mp3&iNoteID=164437>

### **Occupational and Environmental Epidemiology Program (Three Highlights)**

**Program - Director:** *Bruce H. Alexander, PhD, Professor*

**Program – Co-Directors:**

*Richard F. MacLehose, PhD, Assistant Professor*

*Jeffrey H. Mandel, MD, MPH, Associate Professor*

#### **1. Evaluating the Impact of Mineral Dusts and Elongate Mineral Particles on Lung Disease in Taconite Miners**

Drs. Alexander, Mandel, and MacLehose and OEE trainees Christine Lambert, Elizabeth Allen, and Naemeka Odo are finalizing studies on respiratory health in current and former employees of the taconite industry. Taconite mining and milling is a major industry in Minnesota, and the industry is expanding in Wisconsin and Michigan. This research is part of the larger Taconite Worker Health Study identified at: <http://www.taconiteworkers.umn.edu>. The research has linked duration of employment in the taconite industry with mesothelioma risk and indicates a potential association with the elongate mineral particles generated in taconite mining and processing. Taconite workers have higher rates of lung cancer and heart disease than the general population, but the link to occupational exposures is not clear. Ongoing research involves examining taconite exposures and the risk of non-malignant respiratory disease. This work is directly related to the NORA mining sector goals of reducing the impact of lung disease in miners. It will also contribute to NIOSH goals outlined in the Asbestos Fibers and Other Elongate Mineral Particles: State of the Science and Roadmap for Research document.

#### **2. Persistence of PFOA in the Work Environment and Health Effects**

Drs. Alexander and Church and Katherine Raleigh (trainee) completed a study of cancer incidence and mortality in workers employed at an ammonium perfluorooctanoate production facility. Ammonium perfluorooctanoate (APFO) is a surfactant used in many industrial processes, including the manufacture of non-stick coatings like Teflon→. APFO converts to perfluorooctanoic acid (PFOA) in the body and is recognized as a persistent and pervasive global environmental contaminant. This chemical dissociates to perfluorooctanoic acid (PFOA) in the biologic systems. The study evaluated the mortality experience of the APFO manufacturing workers and another worker population from the same company in the region. The cohorts were linked to mortality records and the cancer registries in Minnesota and Wisconsin. With the aid of a detailed exposure reconstruction, the risk of several cancers and other diseases were evaluated in relation to APFO exposure. In this analysis there was no apparent association with APFO exposure and the diseases of interest. The linkage to the cancer registries substantially improved the ability to look at one cancer of particular concern, prostate cancer, as most diagnosed prostate cancers do not result in death. The study was published and available for the review of PFOA and other compounds by the International Agency for Research on Cancer.

#### **3. Occupational Ionizing Radiation Exposure and Cataract formation in Radiologic Technologists.**

Drs. MacLehose and Alexander are working with Craig Meyer (trainee) on a study of cataract incidence in the U.S. Radiologic Technologists (USRT) study. The USRT is the largest study of workers exposed to medical ionizing radiation in the world. There is considerable growth in the use of medical imaging procedures and radiotherapy, which has contributed to a six-fold increase in average annual population dose from medical radiation since 1980. These frequently used procedures carry the risk of exposure to health providers. This research will examine the potential effect of long-term, low dose ionizing radiation exposure on the risk of developing cataracts in a population of over 90,000 radiologic technologists. The study will incorporate historical reconstructed occupational dosimetry and estimates of ultraviolet radiation exposure based on satellite data and residential history, as well as other factors related to cataract development. Additionally, this research will explore applications of boosted regression trees, a model developed in the computer science field, to build more efficient prediction model for cataracts. The goal of this work is to provide methodological advancements that address and adjust for healthy worker survivor biases that are commonly found in occupational epidemiologic cohorts.

## **Continuing Education in Occupational Health and Safety**

**Program Director:** *Julie Alcorn-Webb, RN, MA*

The MCOHS Continuing Education (CE) Program conducted 71 total courses during the past grant year. This program reached 4,818 trainees, totaling 11,502 hours of training. Diverse training needs were met by offering a variety of course formats, including 21 online modules awarding CE credit, 39 in-person courses, and 11 hybrid courses with attendees representing occupational health and safety professionals across disciplines. The CE Program continued to strengthen collaborations with the Wisconsin State and Minnesota Associations of Occupational Health Nurses, the Impairment Without Disability Occupational Medicine physicians, and local chapters of the American Industrial Hygiene Association and the American Society of Safety Engineers, by collaborating on regularly scheduled professional development programs and events. New partnerships were established to provide training to occupational health and safety professionals in corporate settings at 3M and Dow Corporations. Geographically, the MCOHS CE program extended to 50 states and 126 countries, with participants representing 78 counties from our regional service area of Minnesota, North Dakota, South Dakota and Wisconsin.